UW Slides Notes

Slide 1
Thank you for the opportunity to perform this work and report on the last year of the PAPO funded project. We have met, and as we will show today, exceeded the goals of this project.

Slide 2
Today the focus is predominately upon monitoring not reported in March at the Citizens Forum or in May at the BLM PAPO meeting.

Slide 3
Here is the result of internal quality checks, as shown above we can have great confidence in the results of the BTEX surveys.

Slide 4
This is one graph we have shown previously with the highest levels of toluene associated with production on the Mesa and water treatment near Boulder. This has been a consistent pattern for three surveys. Toluene is indicative of the BTEX behavior.

Slide 5
As noted earlier this year NO_x has a different distribution due to emission sources contributions

Slide 6 **PASQUA Conclusion I**
So given the consistency of the iso-concentration contour maps do not see the necessity of large scale surveys unless it is to determine the impact of mitigation efforts in the future. We know where the emission reduction target areas are located. We do however need to get more detail in those areas, more on that later.

Slide 7
Sites were selected based upon understanding gained in 2010 to 2011 monitoring.

Slide 8
Ensuring data quality is paramount. Here we see a fantastic level of agreement, that shows the outcome of striving for excellence.

Slide 9
The lowest levels of ethane at sites away from development, highest levels of ethane within development area

Slide 10
Similar lowest concentration sites however as indicated by passive sampling Mesa North and South relatively high levels of toluene. Significant spiking at Boulder Crest. So we have confirmation that the three BTEX surveys were not exceptions

rather the rule. As noted at the citizens forum earlier this year decided to look at the Boulder Crest area in greater detail. More on that later.

Slide 11
So it is clear that alkenes are negligible and alkanes dominant, with variation apparent for aromatics. While both are associated with natural gas, alkanes are most associated with leakage and aromatics with leakage and condensate handling. The sites away from the center of the development are the lowest concentration sites, namely; UW BSR, DEQ Boulder, Olson Ranch, Mesa TOP and Middle Fork. Those inside the development are higher, namely Mesa North, Mesa South, Boulder 351 and Boulder Crest. Of note Mesa North, Mesa South and Boulder Crest have relatively elevated aromatics.

Slide 12 **PASQUA Conclusion II**
We have gained sufficient ambient data to move to the next step of mobile monitoring closer to emission sources to apportion sources and determine if there are any low hanging fruit.

Slide 13
Here we see the ethane to propane ratio for all 10 sites for all 12 surveys in 2012. the relationship is clear and strong and shows the importance of fugitive and pneumatic natural gas emissions.

Slide 14
There is however variation when aromatic compounds like toluene are considered, we can see a dominant 15:1 line along with occasions with extra toluene. If considered as carbon this would be a 4:1 line. This line is a well mixed oil and gas source not fugitive alone, more on that later.

Slide 15
Two sites appear to have predominately measurement in the 15:1 line. This shows that the DEQ Boulder measures well-mixed air. The same is true for UW BSR with indication of extra toluene as noted for the 2011 data.

Slide 16
These two sites show poor agreement and this is likely due to proximity to different emission sources prior to these becoming better mixed. Depending on the travel time toluene could be removed more rapidly through photochemical reaction.

Slide 17 **PASQUA Conclusion III**
We need to understand the contributing sources.

Slide 18
Is the missing piece motor vehicles or dehydration units, but likely far more so for the latter. Of note is boulder Crest Road and we believe this is influenced by water treatment emissions.

Slide 19 **Next Steps Comment I**
True balance requires an in field measurement approach. Not reliance upon calculation based on reported flow through, that assumes equipment is all the same. It is not. We need to survey emission sources as not all equipment is the same. It is well known that 10% of motor vehicles can contribute 90% of emissions in some cities. This is likely true of most mechanical systems.

Slide 20 **UW Initiative I**
WDEQ asked that UW indicate that these measurements while performed to support the aims of the PAPO funded project were not part of the QAPP for which they provided oversight. While this work was not part of the original monitoring plan it was essential to understand how this source had influenced our main monitoring site during the winter of 2010/2011, a major aim of the project. We have come to understand that the Anticline Disposal facility is a major source of air pollution especially VOC and in particular BTEX. 212 Units are likely equally as important.

Slide 21
Here is the process the largest VOC emissions are likely toward the start of the process. It is a patented process that is designed to produce clean water. If gasoline range VOC then emission would be 150 metric tons/yr. Some view this approach as an over estimation. We will come back to the emissions estimation later.

Slide 22
Here are the locations that we used over the period January through March. Most surveys were just 1 or 2 sites, the last two surveys were more extensive.

Slide 23
The breakthrough was tying together Boulder South Road measurements to the Anticline Disposal Facility, initially through smell and then through measurements and analysis. We have data that indiactes this facility also influences the Boulder Crest site. We are confident that this influence can extend throughout the area given in this map.

Slide 24
Here are the levels of ethane at the sampled sites, these are generally comparable to other PASQUA survey sites.

Slide 25
By contrast toluene levels are extremely elevated above levels measured at other ambient locations. All these measurements are on pubic land.

Slide 26
So taking all 31 measured VOC as ppbC for five different surveys we can see a clear C6 to C8 signature. So what have we learned about this emission source. There are important components but none more so than toluene (35%) and xylene isomers

(30%). As noted in recent presentations these compounds are highly reactive with a high potential for ozone production.

Slide 27
This back of the envelope estimate is a starting point for proper consideration of this major source.

Slide 28 **Next steps Comment II**
In particular as this process emits reactive VOC in the center of the ozone production zone within the non-attainment boundary.

Slide 29
This graph shows the relative % distribution between the identified production and water treatment emissions. It is clear that production dominates for C2 to C5 while water treatment emissions have a relatively higher proportion of C6 to C9 compounds.

Slide 30
Now we can better understand the PMF analysis of the US BSR data from last year. The two factors or behavior patterns most likely relate to well-mixed production emissions in blue and local water treatment emissions in red.

Slide 31 **PASQUA Conclusions IV**
The same can be said for Boulder Crest for water treatment source but for the other sites the BTEX enhancement explanation is less clear but is most likely a combination of proximity to production with variable influence of condensate handling and traffic?

Slide 32
Another UW initiative was to test new prototype VOC passive samplers and volatile PAH passive samplers. PAH are polycyclic aromatic hydrocarbons, these are benzene rings linked together.

Slide 33
Here are the results for Phenathrene, a three ring polycyclic aromatic hydrocarbon associated with combustion in particular cigarette smoke and traffic. Making the assumption that traffic is the source then we can see clear differences between sites. PAH data confirms findings of passive NO_x surveys that showed these sites to have traffic or compression contributions.

Slide 34
The comparison between samplers is spectacular and shows that these samplers may be applied for at least C5 to C9, and perhaps C4.

Slide 35 **Next steps Comment III**

We have the possibility of continuing this work with different diffusive membranes that would allow for sampling at high concentration sites.

Slide 36
Last year we set up 10 meteorological stations with reference to existing sites to better explain the wind field patterns that transported produced ozone to distant receptor sites at Daniel, Pinedale and the Wyoming Range DEQ FEM sites.

Slide 37
We have completed the data collection in late March and are now working on understanding patterns in the winter of 2012. Riverside shows the unusual evenly distributed pattern that has been previously observed in this area. The Mesa site is very different showing the well known dominant NW flow.

Slide 38
Here is a reminder of the use of the Picarro mobile methane system. It has great utility as both ambient and source monitoring.

Slide 39
For the last VOC canister survey we also measured methane in the canisters and we see that the methane to ethane ratio has great utility. The 2011 relationship at UW BSR is added confirmation. We are confident that this relationship extends to high concentrations.

Slide 40 **Next Steps Comment IV**
We see methane as one important part of the puzzle that relates to natural gas leakage.

Slide 41
The UW AQ research group is very grateful to the Wyoming BLM for funding pre-development monitoring work. We are still unfunded for completion of our work supporting efforts in Pinedale. We have worked very hard and are policy neutral and are highly motivated to help mitigate the ozone problem.

Slide 42
Our ambient approach needs to take the next step of mobile monitoring that get closer to emission sources. We have two linked questions to answer. What is the distribution of contributing sources and second surveying.

Slide 43
UW want the opportunity to complete the required research to enable problem resolution for Sublette County ozone issues. We bring more than knowledge to this proposed work plan. We know that we are out of cycle but that is as we did not know if we would need to perform a final study.

Slide 44 **Next Steps Comment IV**

This investment is from reclaimed mines money. Funding is essential to keep Wyoming at the leading edge of this issue. We are working hard to get support and really appreciate the support of the past 2 years from the PAPO board and the UW School of Energy Resources. If unfunded we will be forced to work outside of the State or gain funding from other sources, for example advocacy groups like the EDC or NRDC. We would prefer to use Wyoming funded equipment to help work with regulators and developers to mitigate air quality problems in our State.

Slide 45

We have worked hard to get this far into the problem and we really appreciate your attention. We hope that we will have the opportunity to report next year and finish our work. Thank you.